SALTO
inspired access

Desktop Reader and Wall Reader Adaptor
USER MANUAL

Version: 2.31

Distribution: SALTO customers

DOCUMENT REVISIONS

Version	Date	Modifications
1.2	5/03/2004	
1.3	11/03/2004	Note on Wall Reader Adaptor about minimum wall reader versions.
1.4	12/03/2004	Fixes mistake on Desktop Reader Connector.
1.5	25/03/2004	Minimum WR2000 firmware version to read ROM code from iButtonROM.
1.6	11/08/2005	NEW: ROM code configuration. BCD Data Format (ANSI/ISO): It is used in Track 2 and Track 3. New Card Technologies (Mifare, Desfire…)
2.1	26/02/2007	New Firmware Version 02.01. New RS232 Plain Text Format. New Wiegand formats.
2.2	13/03/2008	New Firmware Version 02.03. New Wiegand format.
2.3	06/06/2008	New Firmware version 02.04. New OMRON format.

CONTENTS

1   Object of this document

This document is the User Manual of two devices:

- Desktop Reader EcxxDR.

- Wall Reader Adaptor WRADAPT.

It covers the functions of the firmware version 02.01.

It is intended to help the PMS and T&A developers to connect their systems to the SALTO access control system.

2   Desktop Reader: ECxxDR

The purpose of the Desktop Reader is to read some data from the cards and give them in a simple manner to an external device, usually a Point Of Sale (POS) terminal.

The Desktop Reader has the same aspect of the RS232 Encoder. It has a 9 pins D-type connector (female) to be connected to the RS232 port of the POS terminal. There are as many Desktop Readers as technologies (Dallas, Smart Card, Legic Proximity) with references **EC20DR, EC50DR** and **EC80DR**.

The interface can be also OMRON and WIEGAND, depending on the dipswitch settings.

2.1   Desktop Reader Setup

The Desktop Reader comes from factory prepared to read Track1 and to give the data through RS232 interface at 19200 bauds, 8 bits and no parity. If other configuration is desired, the case has to be opened, removing the bottom 4 screws, to have access to the Configuration Dipswitches.

Also, the reader part of the Desktop Reader has been connected and tested in the factory so it is no necessary to use the CLR button except in Proximity readers when you need to enter a new SAM card. The CLR button is only accessible opening the case of the Desktop Reader.

2.2   Desktop Reader Connector

The functions of the 9 pins D-type connector are different depending on the selected type of interface:

Interface	D-Type connector pins		
	2	**3**	**5**
RS232	TX	RX	GND
OMRON	DATA	CLOCK	GND
WIEGAND	D1	D0	GND

The Desktop Reader is powered from a plug-in 12V power supply though the jack connector. Central pin is the positive.

The Desktop Reader is continuously looking for a card and when one is presented it sends the data to the external device giving simultaneously a valid signal (green led and beep).

3   Wall Reader Adaptor: WRADAP

The purpose of the Wall Reader Adaptor is to read some data from the cards and give them in a simple manner to an external device, usually a Time and Attendance (T&A) terminal.

The Wall Reader Adaptor is connected by one side to any Salto Wall Reader, WR2000 (WR1000 is not accepted), WR5000, WR8000, WR7000, WR9000 and by the other side to the external device. There is only one model of Wall Reader Adaptor (**WRADAP**) because it is compatible with Wall Readers of different technologies.

Note: The minimum version of wall readers WR2000 (iButton) and WR5000 (Smart) is V2.20 manufactured from 22/10/2003. Previous versions do not work with Track and Wiegand data. *Minimum version to read ROM code from iButtonROM of the WR2000 is V2.41 manufactured from 25/03/2004*. Proximity readers WR7000, WR8000, WR90000 are compatible from the beginning.

3.1 Wall Reader Connection

The Wall Reader is connected to the Adaptor through a 5 pins block connector identical to the CU5000. The functions of the 5 pins are:

1	5 volts power supply (from Adaptor to Wall Reader)
2	PPD connection (not used)
3	Ground
4	Data input-output
5	Card Present

3.2 External Device Connection

The interface with the external device can be RS232, OMRON and WIEGAND. The connection is made through a 4 pins block terminal.

The functions of the 4 pins connector are different depending on the selected type of interface:

Interface Connector	Rx/D0	Tx/D1	GND	+V
RS232	RX	TX	GND	+V
OMRON	CLOCK	DATA	GND	+V
WIEGAND	D0	D1	GND	+V

The Wall Reader Adaptor is powered from the external device through pins +V and GND. Optionally can be powered through the jack connector.

The Wall Reader Adaptor is continuously looking for a card and when one is presented it sends the data to the external device giving simultaneously a valid signal (green led and beep).

3.3 Power Supply

Desktop Reader and Wall Reader Adaptor needs a DC power supply with a voltage between 7 and 15 volt.

The typical current consumption is 15 mA (maximum 30 mA) plus the current consumption of the reader that depends on the technology:

Reader	Technology	Reader Consumption (mA)		Total Consumption (mA)	
		Typical	Maximum	Typical	Maximum
WR2000	iButton	15	30	30	60
WR5000	Smart Card	20	80	35	110
WR8000	Legic	30	50	45	80
WR9000	Mifare	40	120	55	150
WR7000	Picopass	20	60	35	90

4 CLR Button

The CLR Button permits to make a quick diagnosis of the reader. When pressing the CLR button the Led beside the button lights and the Reader gives an orange light as long as the CLR button remains pressed.

The CLR Led lights for a moment each time a card is read with the proper data according to the MODE dipswitches setting.

5 SAM programming process

Some installations working with Mifare, Desfire, Picopass or Legic cards need to program all the readers with the SAM card that carries the Custom-Code. To do that follow the corresponding process:

- **DeskTop Reader**: the CLR button has to be kept pressed until the Encoder accepts the SAM card. If the CLR button is released before finishing the launching process it will be stopped.

- **Wall Reader Adaptor**: press and release the CLR button of the WRADAP and the reader will start a 60 seconds period to enter the SAM card.

SAM cards are accepted in one or two seconds except Legic SAM that lasts around 15 seconds.

6 MODE dip switches table

MODE	Notes	Data	Interface	Format
00000001		Track1	RS232 (19200-8-N)	(STX, ETX, LRC)
00000010		Track2	RS232 (19200-8-N)	(STX, ETX, LRC)
00000011		Track3	RS232 (19200-8-N)	(STX, ETX, LRC)
00000100		**%** + ROM14 + **?**	RS232 (19200-8-N)	(STX, ETX, LRC)
00000101		Track1	RS232 (9600-8-N)	(STX, ETX, LRC)
00000110		Track2	RS232 (9600-8-N)	(STX, ETX, LRC)
00000111		Track3	RS232 (9600-8-N)	(STX, ETX, LRC)
00001000		**%** + ROM14 + **?**	RS232 (9600-8-N)	(STX, ETX, LRC)
00001001	1	Track1	RS232 (19200-8-N)	(PLAIN)
00001010	1	Track2	RS232 (19200-8-N)	(PLAIN)
00001011	1	Track3	RS232 (19200-8-N)	(PLAIN)
00001100	1	ROM14	RS232 (19200-8-N)	(PLAIN)
11000000	5	Track1	OMRON	BCD or ALPHA
11000001	5	Track2	OMRON	BCD or ALPHA
11000010	5	Track3	OMRON	BCD or ALPHA
11000011	5	**%** + ROM14 + **?**	OMRON	ALPHA
11000100		Track1	WIEGAND	BCD or ALPHA
11000101		Track2	WIEGAND	BCD or ALPHA
11000110		Track3	WIEGAND	BCD or ALPHA
11000111		**%** + ROM14 + **?**	WIEGAND	ALPHA
11001000		ROM	WIEGAND	56-bit

MODE	Notes	Data	Interface	Format
11001001		ROM	WIEGAND	56-bit + 2 parity-bits
11001010	1	WIEGAND-CODE	WIEGAND	Format defined in ProAccess software
11001011	1, 4	Facility Code zero (8 bits) plus the two lower bytes of the Serial Number (16 bits) plus two parity bits.	WIEGAND	Standard 26-bit
11001100	1, 4	Three lower bytes of the Serial Number (24 bits) plus two parity bits.	WIEGAND	Standard 26-bit
11001101	2, 4	Four lower bytes of the Serial Number (32 bits) plus two parity bits.	WIEGAND	32-bit + 2 parity-bits
11001110	3, 5, 6	Track2	OMRON	BCD or ALPHA

(1) Only available from firmware version 02.01.

(2) Only available from firmware version 02.03.

(3) Only available from firmware version 02.04.

(4) Only valid for Mifare, Desfire and Vicinity cards.

(5) Used not very often. Kept only for backward compatibility purpouses.

(6) The leading and trailing zeros are not appended.

7   Data

There are three types of data to be read by the Desktop Reader (or Wall Reader Adaptor):

ROM code or Serial Number	This is a factory programmed code particular for each card
TRACKS	Emulates the Tracks 1, 2 and 3 of the magnetic stripe cards.
WIEGAND CODE	Emulates de Wiegand code of access control cards

7.1   ROM code

The Salto ROM code is a 7 byte code different for each card. Normally each byte is expressed as a double hexadecimal character so the total ROM code will be 14 ASCII characters (called ROM14). If the bytes are represented by their 8 bits the total 56 bits representation is called ROM56.

Example:

Format	ROM_6	ROM_5	ROM_4	ROM_3	ROM_2	ROM_1	ROM_0
Bytes	0x11	0x22	0x33	0x44	0x55	0x66	0x77
ROM14	"11223344556677"						
ROM56	00010001001000100011001101000100010101010110011001110111						

7.1.1 ROM code and Serial Number

The relation between the ROM code and the card Serial Number depends on the technology of the card. This table shows the

	ROM6	ROM5	ROM4	ROM3	ROM2	ROM1	ROM0
iButton	FamilyCode	SN5	SN4	SN3	SN2	SN1	SN0
Smart Card SLE4442 SLE5542	ICCF2	ICCF3	ICCF4	ICCSN0	ICCSN1	ICCSN2	ICCSN3
Smart Card AT88SC153 AT88SC1608	IDN0	IDN1	IDN2	IDN3	IDN4	IDN5	IDN6
Legic	0x01	MCD	MSN	MSN	MSN	MCC	0x00
Mifare	UID0	UID1	UID2	UID3	0x00	0x00	0x00
Desfire Vicinity	UID0	UID1	UID2	UID3	UID4	UID5	UID6

IButton: Salto ROM code is the laser-programmed Dallas ROM code including at the beginning the FamilyCode, followed by the Serial Number MSB and excluding the 8th byte that is a checksum. These 7 bytes are engraved on the iButton case, FamilyCode on the right and below it the other 6 bytes.

Smart Card SLE4442/SLE5542: The first three bytes are part of the IC Card Manufacturer Code. Next four bytes are the IC Card Serial Number.

Smart Card AT88SC153 and AT88SC1608: The seven bytes of the Identification Number starting by the LSB.

Legic: First byte is 0x01 (inexistent iButton FamilyCode), 5 bytes of the Serial Number starting by the MDC (Manufacture Code) and finishing by the MCC (Manufacture Check Character) and a final null byte 0x00.

Mifare: The first four bytes are the Unique Identifier (UID) also called Serial Number (SN) of the Mifare card starting by the LSB. Followed by three null bytes (0x00).

Desfire: The seven bytes of the card UID (or Serial Number SN) starting by the LSB.

ISO15693 Vicinity Cards: The seven lower bytes of the UID (or Serial Number SN) starting by the LSB and removing the UID7 that is always 0xE0 in ISO15693 cards. PicoPass cards are included in this type.

7.2 Tracks

They emulate the tracks of the magnetic stripe cards. There are three Tracks available, TRACK1, TRACK2 and TRACK3. The information in the emulated tracks are ASCII characters. However, in the magnetic stripe cards, TRACK1 carries alphanumeric data and TRACK2 and TRACK3 only carry numeric data.

7.3 Wiegand code

It is a special track in the cards (called WiegandCode) that carries information of the Wiegand code.

8 Interfaces

There are three types of electrical interface to the terminal:

- RS232 (with different baud rates)
- OMRON (Clock and Data)
- Wiegand (D0 and D1)

8.1 RS232 interface

The RS232 voltage levels do not follow the standard because they do not give negative voltage but work properly with the modern RS232 interface chips. They use only Rx and Tx without hardware and software handshake.

Logical Data	Rx (volts)	Tx (volts)
Zero (0)	> 1.2	5
One (1)	< 1	0.4

The baud rate, the number of bits (7 or 8) and the parity (N, E, O) are selected in the MODE dipswitch.

8.2 OMRON interface

The OMRON interface emulates the magnetic card readers. The OMRON interface has two outputs: Clock and Data. The Clock and Data outputs in standby are 5 volts. The Data line is negated: 5 volts for a logical Zero and 0 volts for a logical One.

The bit time is 150 us. The Clock remains in the low state 50 us. The Data line has the valid level 50 us before the falling edge of the Clock and is kept valid 50 us after the rising edge of the Clock. So, the terminals can read the Data with the falling or with the rising edge of the Clock, as they prefer. The speed is comparable with magnetic card readers reading tracks of 75 and 210 bpi.

8.3 WIEGAND interface

The Wiegand interface has two outputs: Data0 and Data1. In standby they have 5 volts through 1 Kohms resistor. They represent the corresponding logical level giving a 0 volts pulse (0.4 volts through 47 ohms resistor). The width of the pulse is 90 us and the interval between pulses is 1 ms.

9 Formats

The data can be sent using different encoding tables and adding in some cases control characters and checksums. Some formats are specific for only one interface, others are common to various interfaces.

9.1 RS232 format with STX, ETX and Checksum

The transmitted characters are all printable ASCII characters except 2 control characters that helps to determine where the message starts and finishes:

STX	0x02	Start of message
ETX	0x03	End of message

The frame of the message is:

STX	DATA	ETX	Checksum
0x02	N characters	0x03	1 byte

The **Checksum** is calculated as the OR Exclusive of all the previous bytes including the **STX** and **ETX**. If the manufacturer of the external device wants to simplify the software can skip the **Checksum** testing.

Depending on the source of data the N characters of the **DATA** are:

- Track1, Track2, Track3: exactly the same string of ASCII characters given by the PMS to the HAMS through the Track command.

- ROM14: ROM code of the key expressed as 14 hexadecimal ASCII characters. Each byte of the ROM Code is expressed with two ASCII hex characters. A Start Sentinel ("%") and End Sentinel ("?") are added.

9.2   RS232 Plain Format

It transmits the ASCII characters of Data without **STX**, **ETX** and **Checksum**.

9.3   OMRON Formats: BCD and ALPHA

The ASCII characters of Data have to be translated to BCD or ALPHA codes (see _BCD and ALPHA ISO_) before be sent through the OMRON interface. This format is also available for Wiegand.

9.3.1   BCD or ALPHA format

The standard specifies BCD encoding for Track2 and Track3 and ALPHA encoding for Track1 but it is usual that applications do not follow this rule. To permit these exceptions, the encoding is not selected depending on the Track but on the data carried by the Track. The rule to determine which encoding to be used (BCD or ALPHA) with the Tracks is:

- If all the ASCII characters of the Track are included in the BCD symbol set (0123456789:;<=>?) it uses the BCD encoding (4 bits + parity).

- Otherwise it uses the ALPHA encoding (6 bits + parity). And if the data finishes with the End Sentinel (**?**) the Reader calculates and adds the LRC.

Warning:

If the system expects ALPHA encoding care has to be taken to avoid the possibility that the information of the Track would have only digits because in this particular case the Adaptor would encode it in BCD. For instance, a Track carries the room number, some rooms have letters (SUITE1, 301A) but other rooms have only digits (101, 102). To avoid encode the later in BCD the information in the Track should always include some fixed character not included in the BCD symbol set, for instance the letter R (for ROOM) or just a space before or after every room number.

ROM14 code is always ALPHA encoded adding the Start Sentinel (%), End Sentinel (?) and final LRC.

9.3.2   Syncronization zeros

Before and after the data, the adaptor appends 25 leading and 25 trailing zeros emulating a standard magnetic card reader. This feature was disabled in one of the two availables OMRON modes for track2.

9.4   WIEGAND formats

Byte and bit order: Wiegand interface sends the data always Most Significant Byte First and Most Significant Bit First.

Parity bits: The two parity bits are one Even parity bit of the first half bits at the beginning and one Odd parity bit of the last half bits at the end.

Data for Wiegand is usually ROM code and Serial Number, notice that they are not exactly the same, please find in _ROM code and Serial Number_ the relation between them.

In some configurations Wiegand uses the same formats BCD and ALPHA of the OMRON interface. It sends the bits in the same order they would be sent through the OMRON (Clock and Data) interface, but without adding leading and trailing zeros.

10 Card Technologies

The Desktop Reader and Wall Reader Adaptor are available for all RW technologies: iButton, Smart Cards and Proximity. There are some few exceptions:

- ArenaCards (NAGRA) are not included because they cannot carry Tracks or Wiegand Code, neither do have ROM code.

- I2C smart cards have no ROM Code but can have Track 1, 2 and 3 and Wiegand Code.

- In Legic cards the systems can only read the ROM code of cards with a Salto segment.

11 BCD and ALPHA ISO Standards

The data of tracks 1, 2 and 3 of magnetic stripe cards can be encoded in two ways: BCD and ALPHA formats.

11.1 BCD Data Format (ANSI/ISO)

It is used in Track 2 and Track 3.

Set of characters: 16 characters of 5 bits (4 bits + odd parity). LSB first (Least Significant Bit first) and Parity Bit last. BCD Value = ASCII value – 0x30.

11.2 ALPHA Data Format (ANSI/ISO)

It is used by Track 1.

Set of characters: 64 characters of 7 bits (6 bits + odd parity).). LSB first (Least Significant Bit first) and Parity Bit last. ALPHA value = ASCII value – 0x20.

11.3 BCD and ALPHA table

This table shows the symbols of the BCD and ALPHA formats and the equivalences with their representation as printable characters and ASCII values.

Printable characters	ASCII value (1 byte)	BCD codes (4 bits + parity)	ALPHA codes (6 bits + parity)
Space	0x20		00
!	0x21		01
"	0x22		02
#	0x23		03
$	0x24		04
%	0x25		05 **(SS)**
&	0x26		06
'	0x27		07
(	0x28		08
)	0x29		09
+	0x2A		0A
*	0x2B		0B
,	0x2C		0C
-	0x2D		0D
.	0x2E		0E
/	0x2F		0F
0	0x30	00	10
1	0x31	01	11
2	0x32	02	12
3	0x33	03	13
4	0x34	04	14
5	0x35	05	15

Printable characters	ASCII value (1 byte)	BCD codes (4 bits + parity)	ALPHA codes (6 bits + parity)
6	0x36	06	16
7	0x37	07	17
8	0x38	08	18
9	0x39	09	19
:	0x3A	0A	1A
;	0x3B	0B **(SS)**	1B
<	0x3C	0C	1C
=	0x3D	0D **(FS)**	1D
>	0x3E	0E	1E
?	0x3F	0F **(ES)**	1F **(ES)**
@	0x40		20
A	0x41		21
…letters..	…		…
Z	0x5A		3A
[	0x5B		3B
\	0x5C		3C
]	0x5D		3D
^	0x5E		3E **(FS)**
_	0x5F		3F

(SS) = Start Sentinel

(FS) = Field Separator

(ES) = End Sentinel

11.4 Non ISO cards

Not all the cards follow exactly the ISO standards in the tracks.

Some cards do not limit the use of BCD codes to Track2 and 3 or ALPHA codes to Track1, some others do not use the standard Sentinels or Field Separators.

11.5 LRC

The LRC (Longitudinal Redundancy Code) is the exclusive OR (XOR) including the Start and End Sentinels (SS and ES) in both formats BCD and ALPHA. Its parity is also odd.

11.6 Salto Software PMS Track Commands

The PMS commands for Tracks sends the data in ASCII format. They never add the LRC because the XOR of the characters can give a non-ASCII character and be equal to a control character of the link PMS-HAMS producing a malfunction. The Desktop Reader and the Wall Reader Adaptor will calculate and

add the LRC in OMRON and WIEGAND interfaces if the data of the Track string finishes with the End Sentinel ("?").